

# Better Foresighted than Myopic

## Supporting Decisions about Agricultural Research for Development in Latin America and the Caribbean

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In preparation for GCARD 2010 (Global Conference on Agricultural Research for Development), FORAGRO (Foro de las Américas para la Investigación y el Desarrollo Tecnológico Agropecuario) undertook a consultation to define priorities for agricultural research and development (R&D) in Latin America and the Caribbean (LAC).

In light of global developments since then, several organizations have joined forces to develop a foresight framework that can support strategic planning and decision-making related to agricultural R&D policies and investments in LAC, with the aim of strengthening food security at the local, national, and global levels and fostering sustainable development to generate income and employment for the poor.

As a first step, the partner organizations (see box on page 2) held a workshop at the Banco Interamericano de Desarrollo (BID) in Washington, D.C., during March 2012 to analyze global trends and scenarios. Then, in October 2012, they explored implications for agricultural R&D through an expert consultation at the International Center for Tropical Agriculture (CIAT) in Colombia. Those events resulted in a working paper, which this document summarizes for GCARD 2012.

Foresight studies involve a wide variety of methods, of which scenario building is among the most common. The study described here centers mainly on scenario building, while recognizing that other methods are needed as well. It mostly uses a 2030 horizon but also takes into account some shorter term issues. While recognizing the striking heterogeneity of agriculture in LAC, this study addresses the region as a whole, with

the aim of developing a general framework that could later be adapted for analysis of particular sub-regions, countries, agro-ecological zones, or products.

### Remarkable Changes in Recent Decades

In recent decades, LAC has somewhat outpaced global growth in food availability, with calories per capita rising by 29% and protein by 35% between 1960 and 2009. Meanwhile, the region's agricultural production has increased its share of global output from about 10% in the 1960s to about 13% in the 2000s. During the last 10 years, production in LAC (valued in constant terms) has become slightly larger than that of the European Union or USA plus Canada and has exceeded that of India by almost 30%, while amounting to less than 60% of China's. This increase resulted to a large extent from agricultural expansion in Brazil and also reflects the faster growth of livestock production than crops.

**A global food basket:** During the 2000s, LAC became the world's main net food exporting region, reflecting strongly but not exclusively the net trade surpluses generated by Brazil and Argentina. The share of traditional tropical products (such as coffee, cocoa, sugar, and textiles) in net exports declined, while that of fruits and vegetables, oilseeds, and meat products increased.

**Agricultural expansion:** The remarkable gains in LAC's agriculture, though driven in part by productivity improvement, also resulted from significant expansion of agricultural area over the last half century. The region has contributed a third of the global increase in agricultural land (crops and pastures) since the 1960s.



**Consequences of land-use change:** LAC also accounted for two-thirds of global deforestation from 1990 to 2010. Unsurprisingly, land-use change contributes more to LAC's greenhouse gas (GHG) emissions than any other source, though the region's emissions are comparatively low. Another worrisome consequence of rapid land-use change is the pressure this places on LAC's globally important reservoirs of biodiversity.

**Agriculture's shifting terrain:** Changes in LAC's agriculture have taken place against a background of large inequalities in land tenure. Small farms are becoming more fragmented, while large landholdings expand, with the result that family farms and local communities (along with their traditional production structures and knowledge) are being squeezed out. In addition, technological levels vary significantly between and within countries and across producer groups.

Agricultural production has diversified, as reflected in the changes in exports already mentioned. Key actors in agricultural production, processing, and marketing have seen important shifts, with seed companies providing technology for cereals and oilseeds; meat companies organizing whole value chains through large-scale production of beef, poultry, and pork; and supermarkets structuring the production of fruits, vegetables, and specialty foods.

**Urbanization of poverty:** Poverty in LAC has declined in recent decades, becoming concentrated in urban centers, as rural populations and agricultural employment have fallen significantly.

**Changes in agricultural R&D:** This activity has evolved considerably, starting with the creation of public-sector national agricultural research institutes (NARIs) in the late 1950s, earlier than in other developing regions. Soon afterwards, three of CGIAR's international centers were established in LAC. Over time a regional institutional framework took shape, which included FORAGRO and various sub-regional

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structures. More recently, the private sector – from multinational companies to producer associations – and civil society have also taken up active roles in the development and diffusion of agricultural technology.

Public investment in agricultural R&D has increased somewhat, particularly over the last decade. But LAC's average ratios are well below those of developed nations, and a few countries, notably Brazil, account for much of the improvement, as investment has declined in the smaller and poorer countries that are most in need of agricultural R&D.

**Complex challenges:** The scenario for agricultural R&D in LAC is thus highly complex, going beyond small-scale production of staple crops.

### The Large Margin of Uncertainty

Most prospective studies anticipate significant increases in global food demand (driven by economic and population growth together with supply constraints), which will keep prices high in real terms. LAC is expected to remain an important net agricultural and food exporter, helping stabilize food prices through its major contribution to world trade. Nonetheless, various factors in those projections give them a large margin of uncertainty.

**Global integration and governance:** Key questions are the potential impact of the current financial crisis on the size and composition of the European Union, the future of other regional economic pacts, the ability of global coordination mechanisms to correct world economic imbalances and reduce financial vulnerability, and the evolution of climate change negotiations.

**Growth trends:** Many current projections suggest that GDP per capita will grow at rates exceeding the averages for the last 30 or 50 years. Those projections are based on different variations of economic convergence models, which may overstate future growth.

The period of growth that started in the early 1990s and lasted until recently relied on deepening globalization, expansionary monetary policies, the advance of the European project, and economic restructuring in many developing economies. Expanding global supply was absorbed by additional consumption in developed countries, particularly the USA, where it was fueled by unsustainable credit expansion. This unique combination of factors led to the global imbalances that lie at the center of the current economic crisis.

The main unknowns going forward include: (1) the length of the current crisis and (2) the new growth engines that will spur economic acceleration once the crisis is over.

### **Population trends and consumption patterns:**

Patterns in food consumption are closely linked to incomes, prices, and urbanization. Other factors may have an influence as well, such as market policies and supermarket expansion, health issues, social and ethical values, and concerns about waste. Further uncertainty in projecting future demand arises from meat consumption patterns and the age and gender of the population. While most studies assume a relatively stable demographic structure, aging populations may lead to a decline in calorie intake.

In LAC, continued urbanization is rapidly shifting concerns about poverty and food security to the cities. Increasingly, the region bears a “double burden” of malnutrition, which combines traditional problems of undernourishment with new concerns about overweight, diabetes, and high blood pressure.

**Climate change:** Various models present different projections of climate change outcomes from the same levels of greenhouse gases and aerosols in the atmosphere. The more sophisticated general circulation models (GCM) being used for the Fifth Assessment of the Intergovernmental Panel on Climate Change (IPCC) are likely to further expand the range of potential outcomes at the regional and local levels. At the aggregate level, the world may well be on the way to reaching at least 2°C by 2050, and under increasingly plausible scenarios, temperatures could go even higher. In the short term, more frequent extreme weather already presents a serious problem, which requires different adaptation and risk mitigation measures, including better water management.

**Energy:** Agriculture and energy have important links related to crop production and processing as well as transportation. At the macro-economic level, energy costs affect disposable incomes, and sharp increases in the price of oil have been crucial factors in many global recessions. In world markets, the prices of oil and agricultural commodities have shown a close correlation since at least the 1970s, when they both spiked in response to strong global growth in the 1960s to 1970s together with supply problems.

In the mid-1980s, prices in the two sectors simultaneously collapsed because of declining global growth and supply expansion, driven in part by

technological changes. More recently, biofuel mandates and production have strengthened this price link. A further connection concerns climate-change impacts associated with energy-related GHG emissions.

The future of energy prices is highly uncertain. Some projections suggest that in the next decades real prices will exceed the average for the previous two periods of high prices – i.e., during the 1970s and in the 2000s. This raises important questions about the sustainability of growth rates in the global economy. Also, new technologies for producing shale gas and tight oil in the USA, China, India, and LAC, among other places, may have important ramifications for world agricultural and food production, including the possibility of cheaper fertilizers, some reductions in GHG emissions, and macro-economic impacts on the appreciation of real exchange rates in LAC.

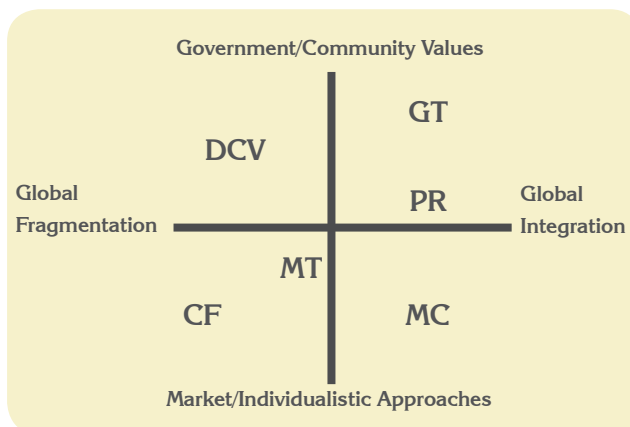
**Technological developments:** Within the vast and changing technological field, there is a marked trend towards the convergence of life sciences (including those related to agriculture) with physics, chemistry, computer sciences, mathematics, and engineering, leading to the emergence of new interdisciplinary research areas that tackle a broad range of scientific and societal problems. Some of these developments could significantly impact agriculture and food security.

The new research areas, because they place new demands on agricultural scientists, require significant capacity building and interdisciplinary integration in LAC. They also pose important institutional challenges. NARIs need to strengthen their human resource and financial management, while also better positioning themselves within the broader science, technology, and innovation policies and structures.

## Six Scenarios for the Future of Agricultural R&D

To build alternative scenarios for agricultural R&D in LAC, the foresight study summarized here used a framework consisting of two axes, as indicated in the accompanying chart. The vertical axis represents the level of government intervention and prevalence of community values versus a market orientation and more individualistic ethics; while the horizontal axis indicates the choice between continued global economic and political integration versus reversion to a more fragmented system of national governance with less economic integration and institutional coordination. This analysis gives rise to six main scenarios:

1. Market Optimism (MO)
2. Policy Reform (PR)
3. Global Transformation (GT)
4. Decentralization with Convergence in Values (DCV)
5. Conflictive Fragmentation (CF)
6. Muddling Through (MT)



The R&D component of those scenarios may be briefly summarized as follows. Those showing a strong market orientation could lead to increasing separation of the public and private sectors. Under such scenarios, the commercial sector will not necessarily internalize the costs of sustainability, while the public sector may focus on a shrinking group of small-scale producers without integrating scientific disciplines and without focusing on innovation.

Under other scenarios, public sector policies and investments could moderate market failures, leading to greater convergence in R&D and better enabling it to address different types of producers and problems, generate public goods, foster national and international networks, and facilitate integration across disciplines. One can also envision more negative scenarios, in which market segmentation together with political fragmentation at the global level lead to greater divergence across countries and economic actors in agriculture and agro-industry. Muddling-through scenarios combine components of the others in different ways.

## First Implication: Playing an Important Role Even Better

As the world's largest net food exporting region, LAC plays a vital role in stabilizing food prices and supplies. Quantitative simulations tend to confirm that the region will continue to influence global food security in the coming decades. LAC is also the developing world's biggest provider of global environmental goods,

including biodiversity and oxygen. Several major staples (beans, cassava, maize, etc.) have their centers of origin and diversity in this region.

LAC thus plays a dual role by contributing both to food security and environmental sustainability at the national and global levels. To play that role effectively, however, the region must intensify R&D along the whole agricultural and food chain, raising the current average ratio of agricultural R&D intensity, which currently stands at just 1% of agricultural GDP. In view of the diverse agrarian structures and rapid urbanization of poverty in LAC, agricultural R&D must also widen its scope beyond the staple crops produced by smallholder farmers to address more complex challenges involving the links between production and concerns about employment, poverty, food security, and environmental sustainability.

Greater concentration at the top of LAC's agrarian structure and increased fragmentation at the bottom is prompting the R&D efforts of the public and private sectors to diverge. Changes in the region's agriculture are driven mainly by the private sector – from farmers to large companies producing agricultural inputs and processing and marketing agricultural and food products. The private sector acts according to market approaches based on estimated costs and benefits. It will not consider price externalities and alternative social objectives without adequate public policies, institutions, and investments related to agricultural R&D. Supporting institutional innovation and expanding human capital and capabilities are particularly important, given that many researchers in LAC's public institutions are approaching retirement age.

## **Second Implication: Sharpening the Focus of R&D**

To address the whole range of questions and issues, foresight studies must use diverse approaches and methods for strategic planning and decisions about technology.

**Focusing on multiple wins:** One helpful approach is to assess technologies according to their ability to generate multiple wins, such as higher yields, lower use of inputs, relevance to family and small farms, resilience in the face of climate change, and gender and race neutrality. CIAT's eco-efficiency approach takes such criteria into account but requires further development of metrics for deciding between R&D options.

**Consumer preference:** Agricultural R&D will need to pay close attention to urban populations and consumer preferences to assist farmers in making choices based on perceived consumer preferences, such as carbon footprint, energy use, biodiversity impacts, and fair-trade approaches. It is also important to consider the region's "double burden" of malnourishment.

**Agriculture and energy:** In addressing agriculture and energy, R&D must include but go beyond biofuels and biomass. Energy efficiency and recycling of energy in the whole agricultural value chain (production, processing, and transportation) can offer multiple wins by reducing costs and GHG emissions.

**Climate change:** Managing and adapting to this risk in LAC's agriculture merit special attention. Extreme weather events, particularly droughts and flooding,





demonstrate the urgent need for building resilience into production systems, including improved water management. Given agriculture's large direct and indirect contributions to GHG emissions, R&D must also deal with climate change mitigation, focusing on forest preservation, carbon sinks, livestock production, and fertilizer use.

***Institutional challenges:*** It is crucial to address these challenges as well, particularly building capacity in public and private organizations; establishing successful cooperation and networks across countries and involving both the public and private sector; engaging local communities that possess traditional knowledge; strengthening innovation; and, crucially, financing all of the above. In view of marked disparities between countries, international and regional networks must help smaller and poorer countries strengthen agricultural R&D programs. Moreover, institutional changes are needed to benefit from the convergence of different sciences and to position R&D in broader innovation strategies.

***Factoring in slower growth:*** High-growth, high-price projections are the usual benchmarks in assessing future trends. But it is also useful to consider less optimistic scenarios that envision slow recovery from the current global financial crisis and the exhaustion of

key growth sources in recent decades. Continuing trade and financial conflicts, if allowed to undermine world economic integration, will likely reinforce slower growth. Under this scenario, food demand and prices may be lower than expected, a trend that could gain strength from the lower food consumption of aging populations and from a serious movement to reduce food waste.

## **Conclusion: Reshaping the Trends**

This review highlights the enormous challenges that lie ahead for agricultural R&D in LAC. Powerful socio-economic drivers could keep this region and the world on a business-as-usual path that may prove to be unsustainable.

To reshape those trends requires multiple interventions that go beyond the scope of agricultural R&D in LAC countries – from global macro-economic imbalances and energy and climate change issues to land distribution problems. For all scenarios, however, higher levels of sustained investment in agricultural technology and innovation in LAC make sense. Greater investment in LAC's agricultural and food production, including R&D, is vital for achieving food security and environmental sustainability – not just in this region but for the entire world.

### ***Further Reading***

[http://www.ciat.cgiar.org/work/latinamerica/Pages/foresight\\_agriculture\\_workshop.aspx](http://www.ciat.cgiar.org/work/latinamerica/Pages/foresight_agriculture_workshop.aspx)

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### ***Acknowledgement***

The research and consultations involved in the LAC foresight activities reported here were made possible through generous contributions from IICA, BID, and FONTAGRO.